



# SEQUENCE LISTING

<110> Neeper, Michael P.  
McClements, William L.  
Jansen, Kathrin U.  
Schultz, Loren D.  
Chen, Ling  
Wang, Xin-Min

<120> SYNTHETIC HUMAN PAPILLOMAVIRUS GENES

<130> 20413YCA

<140> 10/728,131

<141> 2003-12-04

<150> 09/642,405

<151> 2000-08-21

<150> PCT/US00/22932

<151> 2000-08-21

<150> 60/210,143

<151> 2000-06-07

<150> 60/150,728

<151> 1999-08-25

<160> 150

<170> FastSEQ for Windows Version 4.0

<210> 1

<211> 1518

<212> DNA

<213> Artificial Sequence

<220>

<223> Codon-Optimized HPV16 L1

<400> 1

```
atgagcctgt ggctgcccag cgaggccacc gtgtacctgc ctcccgtgcc cgtgagcaag 60
gtggtgagca ccgacgagta cgtggcccgc accaacatct actaccacgc cggcaccagc 120
cgctgctgg ccgtgggcca cccctacttc cccatcaaga agcccaacaa caacaagatc 180
ctggtgcccag aggtgagcgg cctgcagtac cgcgtgttcc gcatccacct gcccgacccc 240
aacaagtctg gcttccccga cacaagcttc tacaaccccg acaccacgc cctggtgtgg 300
gcctgcgtgg gcgtggaggt gggccgcggc cagcccctgg gcgtgggcat cagcggccac 360
cccctgctga acaagctgga cgacaccgag aacgccagcg cctacgccgc caacgccggc 420
gtggacaacc gcgagtgcac cagcatggac tacaagcaga cccagctgtg cctgatcggc 480
tgcaagcctc ccatcggcga gcactggggc aagggcagcc cctgcaccaa cgtggccgtg 540
aaccggcg actgccctcc cctggagctg atcaacaccg tgatccagga cggcgacatg 600
gtggacaccg gcttcggcgc catggacttc accacctgc aggccaacaa gagcgaggtg 660
cccctggaca tctgcaccag catctgcaag taccgccgact acatcaagat ggtgagcgag 720
```

```

ccctacggcg acagcctgtt cttctacctg cgccgcgagc agatgttcgt gcgccacctg 780
ttcaaccgcg ccggcgccgt gggcgagaac gtgcccgcg acctgtacat caagggcagc 840
ggcagcaccg ccaacctggc cagcagcaac tacttcccc ctcccagcgg cagcatgggtg 900
accagcgacg cccaaatctt caacaagccc tactggctgc agcgcgcca gggccacaac 960
aacggcatct gctggggcaa ccagctgttc gtgaccgtgg tggacaccac ccgcagcacc 1020
aacatgagcc tgtgcgccgc catcagcacc agcgagacca cctacaagaa caccaacttc 1080
aaggagtacc tgcgccacgg cgaggagtac gacctgcagt tcatcttcca gctgtgcaag 1140
atcacccctga ccgccgacgt gatgacctac atccacagca tgaacagcac catcctggag 1200
gactggaact tcggcctgca gccccctccc ggcggtaccc tggaggacac ctaccgcttc 1260
gtgaccagac aggcacatcg ctgccagaag cacaccctc ccgctcccaa ggagatccc 1320
ctgaagaagt acaccttctg ggaggtgaac ctgaaggaga agttcagcgc cgacctggac 1380
cagttcccc tgggcccga gttcctgctg caggccggcc tgaaggccaa gcccaagttc 1440
accctgggca agcgcaaggc cacccccacc accagcagca ccagcaccac cgccaagcgc 1500
aagaagcgca agctgtaa
1518

```

&lt;210&gt; 2

&lt;211&gt; 1950

&lt;212&gt; DNA

&lt;213&gt; Artificial Sequence

&lt;220&gt;

&lt;223&gt; Mutant, Codon-Optimized HPV16 E1

&lt;400&gt; 2

```

atggccgacc ccgccggcac caacggcgag gagggcaccg gctgcaacgg ctggttctac 60
gtggaggccg tggaggagaa gaagaccggc gacgccatca gcgacgacga gaacgagaac 120
gacagcgaca ccggcgagga cctggtggac ttcacgtga acgacaacga ctacctgacc 180
caggccgaga ccgagaccgc ccacgccctg ttcacgccc aggaggccaa gcagcaccgc 240
gacgccgtgc aggtgctgaa gcgcaagtac ctgggcagcc ccctgagcga catcagcggc 300
tgcgtcgaca acaacatcag ccccgccctg aaggccatct gcatcgagaa gcagagccgc 360
gccgccaaag gccgcctgtt cgagagcgag gacagcggct acggcaacac cgaggtggag 420
acccagcaga tgctgcaggt ggaggccgc cacgagaccg agaccccctg cagccagtac 480
agcggcggca gcggcgccgg ctgcagccag tacagcagcg gcagcggcgg cgaggcgctg 540
agcgagcgcc acaccatctg ccagaccctt ctgaccaaca tcctgaacgt gctgaagacc 600
agcaacgcca aggcgcctat gctggccaag ttcaaggagc tgtacggcgt gagcttcagc 660
gagctgggtg gccccttcaa gagcaacaag agcacctgct gcgactgggt catcgccgcc 720
ttcggcctga ccccagcat cgccgacagc atcaagacc tgctgcagca gtactgcctg 780
tacctgcaca tccagagcct ggccctgcagc tggggcatgg tgggtgctgt gctggtgcgc 840
tacaagtgcg gcaagaaccg cgagaccatc gagaagctgc tgagcaagct gctgtgcgtg 900
agcccatgt gcatgatgat cgagcctccc aagcttcgca gcaccgccgc cgccctgtac 960
tggtacaaga ccggcatcag caacatcagc gaggtgtacg gcgacacccc cgagtggatc 1020
cagcgccaga ccgtgctgca gcacagcttc aacgactgca ccttcgagct gagccagatg 1080
gtgcagtggg cctacgacaa cgacatcgtg gacgacagcg agatcgcta caagtacgcc 1140
cagctggccg acaccaacag caacgccagc gccttccctga agagcaacag ccaggccaag 1200
atcgtgaagg actgcgccac catgtgccgc cactacaagc gcgccgagaa gaagcagatg 1260
agcatgagcc agtggatcaa gtaccgtgc gaccgcgtgg acgacggcgg cgaccgcaag 1320
cagatcgtga tgttcctgcg ctaccagggc gtggaattca tgagcttcct gaccgccctg 1380
aagcgcttcc tgcagggcac cccaagaag aactgcatcc tgctgtacgg cgccgccaac 1440
accgacaaga gcctgttcgg catgagcctg atgaagttcc tgcagggcag cgtgatctgc 1500
ttcgtgaaca gcaagagcca cttctggctg cagcccctgg ccgacgcaa gatcggcag 1560
ctggacgacg ccaccgtgcc ctgctggaac tacatcgacg acaacctgcg caacgccctg 1620
gacggcaacc tggtagcat ggacgtgaag caccgcccc tggtgcagct gaagtgcctt 1680
cccctgctga tcaccagcaa catcaacgcc ggcaccgaca gccgctggcc ctacctgcac 1740
aaccgcctgg tgggtgtcac cttcccacac gagttcccct tcgacgagaa cggtaacccc 1800
gtgtacgagc tgaacgacaa gaactggaag agcttcttca gccgcacctg gagccgcctg 1860

```

agcctgcacg aggacgagga caaggagaac gacggcgaca gcctgcccac cttcaagtgc 1920  
gtgagcggcc agaacaccaa caccctgtaa 1950

<210> 3  
<211> 1098  
<212> DNA  
<213> Artificial Sequence

<220>  
<223> Mutant, Codon-Optimized HPV16 E2

<400> 3  
atggagaccc tgtgccagcg cctgaacgtg tgccaggaca agatcctgac ccactacgag 60  
aacgacagca ccgacctgcg cgaccacatc gactactgga agcacatgcg cctggcctgc 120  
gccatctact acaaggcccc cgagatgggc ttcaagcaca tcaaccacca ggtgggtgccc 180  
accctggccg tgagcaagaa caaggccctg caggccgccc agctgcagct gaccctggag 240  
accatctaca acagccagta cagcaacgag aagtggaccc tgcaggacgt gagcctggag 300  
gtgtacctga ccgccccac cggtgcatc aagaagcac gctacaccgt ggaggtgcag 360  
ttcgacggcg acatctgcaa caccatgcac tacaccaact ggaccacat ctacatctgc 420  
gaggaggcca gcgtgaccgt ggtggagggc caggtggact actacggcct gtactacgtg 480  
cacgagggca tccgcaccta cttcgtgcag ttcaaggacg acgccgagaa gtacagcaag 540  
aacaaggtgt gggaggtgca cgccggcgcc caggtgatcc tgtgccccac cagcgtgttc 600  
agcagcaacg aggtgagcag ccccgagacc atccgccagc acctggccaa ccacagcgcc 660  
gccaccaca ccaaggccgt ggccctgggc accgaggaga cccagaccac catccagcgc 720  
ccccgcagcg agcccgacac cggaacccc tgccacacca ccaagctgct gcaccgcgac 780  
agcgtggaca gcgccccat cctgaccgcc ttcaacagca gccacaaggg ccgcatcaac 840  
tgcaacagca acaccacccc catcgtgcac ctgaagggcg acgccaacac cctgaagtgc 900  
ctgcgctacc gcttcaagaa gcactgcaag ctgtacaccg ccgtgagcag cacctggcac 960  
tggaccggcc acaacgtgaa gcacaagagc gccatcgtga ccctgacctt cgacagcgag 1020  
tggcagcgcg accagtctct gagccaggtg aagatcccca agaccatcac cgtgagcacc 1080  
ggcttcatga gcattctaa 1098

<210> 4  
<211> 297  
<212> DNA  
<213> Artificial Sequence

<220>  
<223> Mutant, Codon-Optimized HPV16 E7

<400> 4  
atgcacggcg acacccccac cctgcacgag tacatgctgg acctgcagcc cgagaccacc 60  
gacctgtacg gctacggcca gctgaacgac agcagcgagg aggaggacga gatcgacggc 120  
cccgccggcc aggccgagcc cgaccgcgcc cactacaaca tcgtgacctt ctgctgcaag 180  
tgcgacagca ccctgcgcct gtgcgtgcag agcaccacg tggacatccg caccctggag 240  
gacctgctga tgggcaccct gggcatcgtg tgccccatct gcagccagaa gccctaa 297

<210> 5  
<211> 297  
<212> DNA  
<213> Artificial Sequence

<220>  
<223> Codon-Optimized HPV6a E7

<400> 5  
 atgcacggcc gccacgtgac cctgaaggac atcgtgctgg acctgcagcc tcccgacccc 60  
 gtgggcctgc actgctacga gcagctgggtg gacagcagcg aggacgaggt ggacgaggtg 120  
 gacggccagg acagccagcc cctgaagcag cacttccaga tcgtgacctg ctgctgcggc 180  
 tgcgacagca acgtgcgcct ggtgggtgcag tgcaccgaga ccgacatccg cgaggtgcag 240  
 cagctcctgc tgggtaccct gaacatcgtg tgccccatct gcgctcccaa gacctaa 297

<210> 6  
 <211> 318  
 <212> DNA  
 <213> Artificial Sequence

<220>  
 <223> Codon-Optimized HPV18 E7

<400> 6  
 atgcacggcc ccaaggccac cctgcaggac atcgtgctgc acctggagcc ccagaacgag 60  
 atccccgtgg acctgctgtg ccacgagcag ctgagcgaca gcgaggagga gaacgacgag 120  
 atcgacggcg tgaaccacca gcacctgccc gctcgcaggg ccgagcccca gcgccacacc 180  
 atgctgtgca tgtgctgcaa gtgcgaggcc cgcctcgagc tgggtgggtgga gagcagcgct 240  
 gacgacctgc gcgccttcca gcagctgttc ctgaacaccc tgagcttcgt gtgcccctgg 300  
 tgcgccagcc agcagtaa 318

<210> 7  
 <211> 1107  
 <212> DNA  
 <213> Artificial Sequence

<220>  
 <223> Codon-Optimized HPV6a E2

<400> 7  
 atggaggcca tcgccaagcg cctggacgcc tgccaggagc agctgctgga gctgtacgag 60  
 gagaacagca ccgacctgca caagcacgtg ctgcaactgga agtgcctgag ccacgagagc 120  
 gtgctgctgt acaaggccaa gcagatgggc ctgagccaca tcggcatgca ggtgggtgct 180  
 cctctgaagg tgagcgaggc caagggccac aacgccatcg agatgcagat gcacctcgag 240  
 agcctgctgc gcaccgagta cagcatggag ccctggacct tgcaggagac cagctacgag 300  
 atgtggcaga cccctcccaa gcgctgcttc aagaagcgcg gcaagaccgt ggaggtgaag 360  
 ttcgacggct gcgccaacaa caccatggac tacgtgggtg ggaccgacgt gtacgtgcag 420  
 gacaacgaca cctgggtgaa ggtgcacagc atggtggacg ccaagggcat ctactacacc 480  
 tgtggccagt tcaagacctg ctacgtgaac ttcgtgaagg aggccgagaa gtacggcagc 540  
 accaagcact gggagggtgtg ctacggcagc accgtgatct gcagccccgc tagcgtgagc 600  
 agcaccaccc aggaggtgag catccccgag agcaccacct acactcccg cagaccagc 660  
 accctggtga gcagcagcac caaggaggac gccgtgcaga cccctcctcg caagcgcgcc 720  
 cgcggcgtgc agcagagccc ctgcaacgcc ctgtgcgtgg cccacatcgg ccccggtgat 780  
 agcggcaacc acaacctgat caccaacaac cagcaccagc accagcgccg caacaacagc 840  
 aacagcagcg ccaactcccat cgtgcagttc caggggcgaga gcaactgcct gaagtgttc 900  
 cgctaccgcc tgaacgatcg ccaccgccac ctgttcgacc tgatcagcag cacctggcac 960  
 tggggccagca gcaaggctcc ccacaagcac gccatcgtga ccgtgacctg cgacagcgag 1020  
 gagcagcgcc agcagttcct ggacgtgggtg aagatccctc ccaccatcag ccacaagctg 1080  
 ggcttcatga gcctgcacct gctgtaa 1107

<210> 8  
 <211> 1098  
 <212> DNA

<213> Artificial Sequence

<220>

<223> Codon-Optimized HPV18 E2

<400> 8

```

atgcagactc ccaaggagac cctgagcgag cgcctgagcg ccctgcagga caagatcatc 60
gaccactacg agaacgacag caaggacatc gacagccaga tccagtactg gcagctgata 120
cgctggggaga acgccatctt cttcgccgct cgcgagcacg ggatccagac cctgaaccac 180
caggtggtgc ccgcctacaa catcagcaag agcaaggccc acaaggccat cgagctgcag 240
atggccctgc agggcctggc ccagagcgcc tacaagaccg aggactggac cctgcaggac 300
acctgcgagg agctgtggaa caccgagccc acccactgct tcaagaaggg aggccagacc 360
gtgcaggtgt acttcgacgg caacaaggac aactgcatga actacgtggc ctgggacagc 420
gtgtactaca tgaccgacgc cggcacctgg gacaagaccg ccacctgctg gagccaccgc 480
ggcctgtact acgtgaagga gggctacaac accttctaca tcgagttcaa gagcgagtgc 540
gagaagtacg gcaacaccgg cacctgggag gtgcacttcg gcaacaacgt gatcgactgc 600
aacgacagca tgtgcagcac cagcgacgac accgtgagcg ccaccagctt ggtgaagcag 660
ctgcagcaca ctcccagccc ctacagcagc accgtgagcg tgggcaccgc caagacctac 720
ggccagacca gcgcggccac tcgcctggc cactgcggcc tggccgagaa gcagcactgc 780
gggcccgtga accctctgct gggcgccgcc accgccaccg gcaacaacaa gcgccgaag 840
ctgtgcagcg gcaacaccac tcccatcatc cacctgaagg gcgaccgcaa cagcctgaag 900
tgcctgcggt accgcctgcg caagcacagc gaccactacc gcgacatcag cagcacctgg 960
cactggaccg gcgcggggaa cgagaagacc ggcacccctga ccgtgaccta ccacagcgag 1020
acccagcgca ccaagttcct gaacaccgtg gccatccccg acagcgtgca gatcctgggt 1080
ggctacatga ccatgtaa                                     1098

```

<210> 9

<211> 129

<212> DNA

<213> Artificial Sequence

<220>

<223> Codon-Optimized HPV16 L1 fragment

<400> 9

```

atgagcctgt ggctgcccag cgaggccacc gtgtacctgc ctcccgtgcc cgtgagcaag 60
gtggtgagca ccgacgagta cgtggcccgc accaaccatc actaccacgc cggcaccagc 120
cgctgctg                                     129

```

<210> 10

<211> 129

<212> DNA

<213> Artificial Sequence

<220>

<223> Codon-Optimized HPV16 L1 fragment

<400> 10

```

cgcacccacc tgcccagacc caacaagtgc ggcttccccg acacaagctt ctacaacccc 60
gacacccagc gcctgggtgt ggctgctgtg ggcgtggagg tgggcccgcg ccagcccctg 120
ggcgtgggc                                     129

```

<210> 11

<211> 129

<212> DNA

<213> Artificial Sequence

<220>

<223> Codon-Optimized HPV16 L1 fragment

<400> 11

```
gagtgcata gcatggacta caagcagacc cagctgtgcc tgatcggctg caagcctccc 60
atcggcgagc actggggcaa gggcagcccc tgcaccaacg tggccgtgaa ccccggcgac 120
tgccctccc                                     129
```

<210> 12

<211> 132

<212> DNA

<213> Artificial Sequence

<220>

<223> Codon-Optimized HPV16 L1 fragment

<400> 12

```
gccaacaaga gcgagggtgcc cctggacatc tgcaccagca tctgcaagta ccccgactac 60
atcaagatgg tgagcgagcc ctacggcgac agcctgttct tctacctgcy ccgcgagcag 120
atgttcgtgc gc                                     132
```

<210> 13

<211> 129

<212> DNA

<213> Artificial Sequence

<220>

<223> Codon-Optimized HPV16 L1 fragment

<400> 13

```
gccagcagca actacttccc cactcccagc ggcagcatgg tgaccagcga cgcccaaata 60
ttcaacaagc cctactggct gcagcgcgcc cagggccaca acaacggcat ctgctggggc 120
aaccagctg                                     129
```

<210> 14

<211> 135

<212> DNA

<213> Artificial Sequence

<220>

<223> Codon-Optimized HPV16 L1 fragment

<400> 14

```
gagtacctgc gccacggcga ggagtacgac ctgcagttca tcttccagct gtgcaagatc 60
accctgaccg ccgacgtgat gacctacatc cacagcatga acagcaccat cctggaggac 120
tggaacttcg gcctg                                     135
```

<210> 15

<211> 135

<212> DNA

<213> Artificial Sequence

<220>

<223> Codon-Optimized HPV16 L1 fragment

<400> 15  
gctcccaagg aggatcccct gaagaagtac accttctggg aggtgaacct gaaggagaag 60  
ttcagcgccg acctggacca gttccccctg ggccgcaagt tctgctgca ggccggcctg 120  
aaggccaagc ccaag 135

<210> 16  
<211> 135  
<212> DNA  
<213> Artificial Sequence

<220>  
<223> Codon-Optimized HPV16 L1 fragment

<400> 16  
gttgggggtcg ggcaggtgga tgcggaacac gcggtactgc aggccgctca ccttgggcac 60  
caggatcttg ttgttggttg gcttcttgat ggggaagtag ggggtggcca cgccagcag 120  
gcggtggtg ccggc 135

<210> 17  
<211> 132  
<212> DNA  
<213> Artificial Sequence

<220>  
<223> Codon-Optimized HPV16 L1 fragment

<400> 17  
cttgtagtcc atgctgatgc actcgcggtt gtccacgccc gcgttggcgg cgtaggcgct 60  
ggcgttctcg gtgtcgtcca gcttggtcag cagggggttg ccgctgatgc ccacgcccag 120  
gggctggccc cg 132

<210> 18  
<211> 129  
<212> DNA  
<213> Artificial Sequence

<220>  
<223> Codon-Optimized HPV16 L1 fragment

<400> 18  
caggggcacc tcgctcttgt tggcctgcag ggtggtgaag tccatggcgc cgaagccggt 60  
gtccaccatg tcgccgtcct ggatcacggt gttgatcagc tccaggggag ggcagtcgcc 120  
ggggttcac 129

<210> 19  
<211> 132  
<212> DNA  
<213> Artificial Sequence

<220>  
<223> Codon-Optimized HPV16 L1 fragment

<400> 19

gggagtgggg aagtagttgc tgctggccag gttggcggtg ctgccgctgc cttgatgta 60  
 caggtcgtcg ggcacgttct cgccacggc gccggcgcg ttgaacaggt ggcgcacgaa 120  
 catctgctcg cg 132

<210> 20  
 <211> 144  
 <212> DNA  
 <213> Artificial Sequence

<220>  
 <223> Codon-Optimized HPV16 L1 fragment

<400> 20  
 ctccctgccg tggcgaggt actccttgaa gttggtgttc ttgtaggtgg tctcgctggt 60  
 gctgatggcg gcgcacaggc tcatgttggg gctgcgggtg gtgtccacca cggtcacgaa 120  
 cagctgggtt ccccgacaga tgcc 144

<210> 21  
 <211> 132  
 <212> DNA  
 <213> Artificial Sequence

<220>  
 <223> Codon-Optimized HPV16 L1 fragment

<400> 21  
 cttcagggga tcttccttgg gagcgggagg ggtgtgcttc tggcaggcga tggcctggct 60  
 ggtcacgaag cggtaggtgt cctccagggt accgccggga gggggctgca ggccgaagtt 120  
 ccagtctcc ag 132

<210> 22  
 <211> 123  
 <212> DNA  
 <213> Artificial Sequence

<220>  
 <223> Codon-Optimized HPV16 L1 fragment

<400> 22  
 cactagagat ctgaattctt acagcttgcg cttcttgccg ttggcggtgg tgctggtgct 60  
 gctggtggtg ggggtggcct tgcgcttgcc cagggtgaac ttgggcttgg cttcaggcc 120  
 gcc 123

<210> 23  
 <211> 21  
 <212> DNA  
 <213> Artificial Sequence

<220>  
 <223> Codon-Optimized HPV16 L1 fragment

<400> 23  
 cgcgccagc ccctgggcgt g 21

<210> 24

<211> 24  
 <212> DNA  
 <213> Artificial Sequence  
  
 <220>  
 <223> Codon-Optimized HPV16 L1 fragment  
  
 <400> 24  
 gccacgccc aggggctggc cgcg 24  
  
 <210> 25  
 <211> 21  
 <212> DNA  
 <213> Artificial Sequence  
  
 <220>  
 <223> Codon-Optimized HPV16 L1 fragment  
  
 <400> 25  
 gccacaaga gcgaggtgcc c 21  
  
 <210> 26  
 <211> 24  
 <212> DNA  
 <213> Artificial Sequence  
  
 <220>  
 <223> Codon-Optimized HPV16 L1 fragment  
  
 <400> 26  
 caggggcacc tcgctcttgt tggc 24  
  
 <210> 27  
 <211> 23  
 <212> DNA  
 <213> Artificial Sequence  
  
 <220>  
 <223> Codon-Optimized HPV16 L1 fragment  
  
 <400> 27  
 gccagcagca actacttccc cac 23  
  
 <210> 28  
 <211> 23  
 <212> DNA  
 <213> Artificial Sequence  
  
 <220>  
 <223> Codon-Optimized HPV16 L1 fragment  
  
 <400> 28  
 gggagtgggg aagtagttgc tgc 23  
  
 <210> 29

```

<211> 24
<212> DNA
<213> Artificial Sequence

<220>
<223> Codon-Optimized HPV16 L1 fragment

<400> 29
ctggaggact ggaacttcgg cctg                24

<210> 30
<211> 24
<212> DNA
<213> Artificial Sequence

<220>
<223> Codon-Optimized HPV16 L1 fragment

<400> 30
caggccgaag ttccagtcct ccag                24

<210> 31
<211> 25
<212> DNA
<213> Artificial Sequence

<220>
<223> Codon-Optimized HPV16 L1 fragment

<400> 31
cactagagat ctgaattcct acagc                25

<210> 32
<211> 38
<212> DNA
<213> Artificial Sequence

<220>
<223> Codon-Optimized HPV16 L1 fragment

<400> 32
catctcagat ctgccaccat gaggcctgtgg ctgcccag        38

<210> 33
<211> 129
<212> DNA
<213> Artificial Sequence

<220>
<223> Codon-Optimized HPV16 E1 fragment

<400> 33
atggccgacc ccgccggcac caacggcgag gagggcaccg gctgcaacgg ctggttctac 60
gtggaggccg tgggtggagaa gaagaccggc gacgccatca gcgacgacga gaacgagaac 120
gacagcgac                                     129

```

<210> 34  
 <211> 132  
 <212> DNA  
 <213> Artificial Sequence

<220>  
 <223> Codon-Optimized HPV16 E1 fragment

<400> 34  
 gtgctgcttg gcctcctggg cggatgaacag ggcgtgggag gtctcgggtct cggcctgggt 60  
 caggtagtcg ttgtcgttca cgatgaagtc caccagggtcc tcgccgggtgt cgctgtcgtt 120  
 ctgcttctcg tc 132

<210> 35  
 <211> 132  
 <212> DNA  
 <213> Artificial Sequence

<220>  
 <223> Codon-Optimized HPV16 E1 fragment

<400> 35  
 gccagagg ccaagcagca ccgcgacgcc gtgcagggtgc tgaagcgcaa gtacctgggc 60  
 agccccctga gcgacatcag cggctgcgtc gacaacaaca tcagcccccg cctgaaggcc 120  
 atctgcatcg ag 132

<210> 36  
 <211> 131  
 <212> DNA  
 <213> Artificial Sequence

<220>  
 <223> Codon-Optimized HPV16 E1 fragment

<400> 36  
 ctgctggcgg ccctccacct gcagcatctg ctgggtctcc acctcgggtgt tgccgtagcc 60  
 gctgtcctcg ctctcgaaca ggcggcgctt ggcggcgagg ctctgcttct cgatgcagat 120  
 ggccttcagg c 131

<210> 37  
 <211> 132  
 <212> DNA  
 <213> Artificial Sequence

<220>  
 <223> Codon-Optimized HPV16 E1 fragment

<400> 37  
 cagggtggagg gccgccacga gaccgagacc ccctgcagcc agtacagcgg cggcagcggc 60  
 ggcgggtgca gccagtacag cagcggcagc ggcggcgagg gcgtgagcga gcgccacacc 120  
 atctgccaga cc 132

<210> 38  
 <211> 135

<212> DNA

<213> Artificial Sequence

<220>

<223> Codon-Optimized HPV16 E1 fragment

<400> 38

```
cttgaagggg cgcaccagct cgctgaagct cagcgcgtac agtccttga acttggccag 60
catggcggcc ttggcgttgc tggctttcag caggttcagg atgttggtca gaggggtctg 120
gcagatgggtg tggcg                                     135
```

<210> 39

<211> 135

<212> DNA

<213> Artificial Sequence

<220>

<223> Codon-Optimized HPV16 E1 fragment

<400> 39

```
gagctgggtgc gccccttcaa gagcaacaag agcacctgct gcgactgggtg catcgccgcc 60
ttcggcctga ccccagcat cgccgacagc atcaagacct tgctgcagca gtactgcctg 120
tacctgcaca tccag                                     135
```

<210> 40

<211> 136

<212> DNA

<213> Artificial Sequence

<220>

<223> Codon-Optimized HPV16 E1 fragment

<400> 40

```
catgggggtc acgcacagca gcttgctcag cagcttctcg atgggtctcgc ggttcttgcc 60
gcacttgtag cgcaccagca gcagcaccac catgccccag ctgcaggcca ggctctggat 120
gtgcaggtag aggcag                                     136
```

<210> 41

<211> 132

<212> DNA

<213> Artificial Sequence

<220>

<223> Codon-Optimized HPV16 E1 fragment

<400> 41

```
ctgctgtgcg tgagcccat gtgcatgatg atcgagcctc ccaagcttcg cagcaccgcc 60
gccgccctgt actggtacaa gaccggcatc agcaacatca gcgaggtgta cggcgacacc 120
cccgagtgga tc                                         132
```

<210> 42

<211> 129

<212> DNA

<213> Artificial Sequence

&lt;220&gt;

&lt;223&gt; Codon-Optimized HPV16 E1 fragment

&lt;400&gt; 42

```

ggcgatctcg ctgtcgtcca cgatgtcgtt gtcgtaggcc cactgcacca tctggctcag 60
ctcgaagggtg cagtcgttga agctgtgctg cagcacggtc tggcgctgga tccactcggg 120
ggtgtcgcc                                     129

```

&lt;210&gt; 43

&lt;211&gt; 129

&lt;212&gt; DNA

&lt;213&gt; Artificial Sequence

&lt;220&gt;

&lt;223&gt; Codon-Optimized HPV16 E1 fragment

&lt;400&gt; 43

```

gtggacgaca gcgagatcgc ctacaagtac gccagctgg ccgacaccaa cagcaacgcc 60
agcgccttcc tgaagagcaa cagccaggcc aagatcgtga aggactgcgc caccatgtgc 120
cgccactac                                     129

```

&lt;210&gt; 44

&lt;211&gt; 129

&lt;212&gt; DNA

&lt;213&gt; Artificial Sequence

&lt;220&gt;

&lt;223&gt; Codon-Optimized HPV16 E1 fragment

&lt;400&gt; 44

```

gtagcgcagg aacatcacga tctgcttgcg gtcgccgccg tcgtccacgc ggtcgcagcg 60
gtacttgatc cactggctca tgctcatctg cttcttctcg gcgcgcttgt agtggcggca 120
catggtggc                                     129

```

&lt;210&gt; 45

&lt;211&gt; 129

&lt;212&gt; DNA

&lt;213&gt; Artificial Sequence

&lt;220&gt;

&lt;223&gt; Codon-Optimized HPV16 E1 fragment

&lt;400&gt; 45

```

cagatcgtga tggtcctgcg ctaccagggc gtggaattca tgagcttcct gaccgccctg 60
aagcgcttcc tgcagggcat cccaagaag aactgcatcc tgctgtacgg cgccgccaac 120
accgacaag                                     129

```

&lt;210&gt; 46

&lt;211&gt; 130

&lt;212&gt; DNA

&lt;213&gt; Artificial Sequence

&lt;220&gt;

&lt;223&gt; Codon-Optimized HPV16 E1 fragment

<400> 46  
 gccgatcttg gcgtcggcca ggggctgcag ccagaagtgg ctcttgctgt tcacgaagca 60  
 gatcacgtg ccctgcagga acttcatcag gctcatgccg aacaggctct tgcggtgtt 120  
 ggcggcgccg 130

<210> 47  
 <211> 129  
 <212> DNA  
 <213> Artificial Sequence

<220>  
 <223> Codon-Optimized HPV16 E1 fragment

<400> 47  
 ctggccgacg ccaagatcgg catgctggac gacgccaccg tgccctgctg gaactacatc 60  
 gacgacaacc tgcgcaacgc cctggacggc aacctggtga gcatggacgt gaagcaccgc 120  
 cccctggtg 129

<210> 48  
 <211> 132  
 <212> DNA  
 <213> Artificial Sequence

<220>  
 <223> Codon-Optimized HPV16 E1 fragment

<400> 48  
 gaactcgttg ggggaaggtga acaccaccag gcggttgtgc aggtagggcc agcggctgtc 60  
 ggtgccggcg ttgatgttgc tggatgatcag caggggaggg cacttcagct gcaccagggg 120  
 gcggtgcttc ac 132

<210> 49  
 <211> 126  
 <212> DNA  
 <213> Artificial Sequence

<220>  
 <223> Codon-Optimized HPV16 E1 fragment

<400> 49  
 gtgttcacct tccccaacga gttccccttc gacgagaacg gtaaccccggt gtacgagctg 60  
 aacgacaaga actggaagag cttcttcagc cgcacctgga gccgcctgag cctgcacgag 120  
 gacgag 126

<210> 50  
 <211> 105  
 <212> DNA  
 <213> Artificial Sequence

<220>  
 <223> Codon-Optimized HPV16 E1 fragment

<400> 50  
 catgagagat ctttacaggg tgttggtgtt ctggccgctc acgcacttga aggtggggcag 60  
 gctgtcgccg tcgttctcct tgcctcgtc ctcgtcagg ctcag 105

```

<210> 51
<211> 23
<212> DNA
<213> Artificial Sequence

<220>
<223> Codon-Optimized HPV16 E1 fragment

<400> 51
gcctgaaggc catctgcatc gag                23

<210> 52
<211> 23
<212> DNA
<213> Artificial Sequence

<220>
<223> Codon-Optimized HPV16 E1 fragment

<400> 52
ctcgatgcag atggccttca ggc                23

<210> 53
<211> 21
<212> DNA
<213> Artificial Sequence

<220>
<223> Codon-Optimized HPV16 E1 fragment

<400> 53
gagctggtgc gccccttcaa g                21

<210> 54
<211> 21
<212> DNA
<213> Artificial Sequence

<220>
<223> Codon-Optimized HPV16 E1 fragment

<400> 54
cttgaagggg cgcaccagct c                21

<210> 55
<211> 21
<212> DNA
<213> Artificial Sequence

<220>
<223> Codon-Optimized HPV16 E1 fragment

<400> 55
ctgctgtgcg tgagccccat g                21

```

```

<210> 56
<211> 21
<212> DNA
<213> Artificial Sequence

<220>
<223> Codon-Optimized HPV16 E1 fragment

<400> 56
catggggctc acgcacagca g                21

<210> 57
<211> 21
<212> DNA
<213> Artificial Sequence

<220>
<223> Codon-Optimized HPV16 E1 fragment

<400> 57
gccaccatgt gccgccacta c                21

<210> 58
<211> 21
<212> DNA
<213> Artificial Sequence

<220>
<223> Codon-Optimized HPV16 E1 fragment

<400> 58
gtagtggcgg cacatggtgg c                21

<210> 59
<211> 21
<212> DNA
<213> Artificial Sequence

<220>
<223> Codon-Optimized HPV16 E1 fragment

<400> 59
ctggccgacg ccaagatcgg c                21

<210> 60
<211> 21
<212> DNA
<213> Artificial Sequence

<220>
<223> Codon-Optimized HPV16 E1 fragment

<400> 60
gccgatcttg gcgtcggcca g                21

```

```

<210> 61
<211> 24
<212> DNA
<213> Artificial Sequence

<220>
<223> Codon-Optimized HPV16 E1 fragment

<400> 61
gtgttcacct tccccaacga gttc                24

<210> 62
<211> 24
<212> DNA
<213> Artificial Sequence

<220>
<223> Codon-Optimized HPV16 E1 fragment

<400> 62
gaactcgttg gggaaggtga acac                24

<210> 63
<211> 25
<212> DNA
<213> Artificial Sequence

<220>
<223> Codon-Optimized HPV16 E1 fragment

<400> 63
catgagagat ctttacaggg tgttg                25

<210> 64
<211> 38
<212> DNA
<213> Artificial Sequence

<220>
<223> Codon-Optimized HPV16 E1 fragment

<400> 64
catctcagat ctgccaccat ggccgacccc gccggcac  38

<210> 65
<211> 99
<212> DNA
<213> Artificial Sequence

<220>
<223> Codon-Optimized HPV16 E2 fragment

<400> 65
atggagaccc tgtgccagcg cctgaacgtg tgccaggaca agatcctgac ccactacgag 60

```

aacgacagca ccgacctgcg cgaccacatc gactactgg

99

<210> 66

<211> 104

<212> DNA

<213> Artificial Sequence

<220>

<223> Codon-Optimized HPV16 E2 fragment

<400> 66

ccaccaggtg gtgcccaccc tggccgtgag caagaacaag gccctgcagg ccgccgagct 60  
gcagctgacc ctggagacga tctacaacag ccagtacagc aacg 104

<210> 67

<211> 108

<212> DNA

<213> Artificial Sequence

<220>

<223> Codon-Optimized HPV16 E2 fragment

<400> 67

ccggctgcat caagaagcac ggctacaccg tggaggtgca gttcgacggc gacatctgca 60  
acaccatgca ctacaccaac tggaccaca ttacatctg tgaggagg 108

<210> 68

<211> 104

<212> DNA

<213> Artificial Sequence

<220>

<223> Codon-Optimized HPV16 E2 fragment

<400> 68

cgtgcacgag gggatccgca cctacttcgt gcagttcaag gacgacgccg agaagtacag 60  
caagaacaag gtgtgggagg tgcacgccg aggccaggtg atcc 104

<210> 69

<211> 110

<212> DNA

<213> Artificial Sequence

<220>

<223> Codon-Optimized HPV16 E2 fragment

<400> 69

ggccaaccac agcgccgcca cccacaccaa ggccgtggcc ctgggcaccg aggagaccca 60  
gaccacaatc cagcgccctc gcagcgagcc cgacaccggc aaccctgcc 110

<210> 70

<211> 107

<212> DNA

<213> Artificial Sequence

&lt;220&gt;

&lt;223&gt; Codon-Optimized HPV16 E2 fragment

&lt;400&gt; 70

```
gccacaaggg ccggatcaac tgcaacagca acaccacccc tatcgtgcac ctgaagggcg 60
acgccaacac cctgaagtgc ctgcggtacc gcttcaagaa gcactgc 107
```

&lt;210&gt; 71

&lt;211&gt; 113

&lt;212&gt; DNA

&lt;213&gt; Artificial Sequence

&lt;220&gt;

&lt;223&gt; Codon-Optimized HPV16 E2 fragment

&lt;400&gt; 71

```
ccaggggtggg caccacctgg tggttgatgt gcttgaagcc catctcgagg gccttgtagt 60
agatggcgca ggccaggcgc atgtgcttcc agtagtcgat gtggtcgcgc agg 113
```

&lt;210&gt; 72

&lt;211&gt; 101

&lt;212&gt; DNA

&lt;213&gt; Artificial Sequence

&lt;220&gt;

&lt;223&gt; Codon-Optimized HPV16 E2 fragment

&lt;400&gt; 72

```
gccgtgcttc ttgatgcagc cggtaggggc ggtaggtac acctccaggc tcacgtcctg 60
caggggtccac ttctcggttc tgtactggct gttgtagatc g 101
```

&lt;210&gt; 73

&lt;211&gt; 98

&lt;212&gt; DNA

&lt;213&gt; Artificial Sequence

&lt;220&gt;

&lt;223&gt; Codon-Optimized HPV16 E2 fragment

&lt;400&gt; 73

```
ggtgcggatc ccctcgtgca cgtagtagag gccgtagtag tccacctggc cctccaccac 60
ggtcacgctg gcctcctcac agatgtaaata gtgggtcc 98
```

&lt;210&gt; 74

&lt;211&gt; 110

&lt;212&gt; DNA

&lt;213&gt; Artificial Sequence

&lt;220&gt;

&lt;223&gt; Codon-Optimized HPV16 E2 fragment

&lt;400&gt; 74

```
gggtggcggc gctgtggttg gccaggtgct ggcggatcgt ctgggggctg ctcacctcgt 60
tgctgctgaa cagcgtgggtg gggcacagga tcacctggcc tccggcgtgc 110
```

<210> 75  
 <211> 111  
 <212> DNA  
 <213> Artificial Sequence  
  
 <220>  
 <223> Codon-Optimized HPV16 E2 fragment  
  
 <400> 75  
 gcagttgac cggcccttgt ggctgctgtt gaaggcggtc aggatagggg cgctgtcgac 60  
 gctgtcgagg tgcagcagct tggtaggtgtg gcaggggttg ccggtgtcgg g 111  
  
 <210> 76  
 <211> 110  
 <212> DNA  
 <213> Artificial Sequence  
  
 <220>  
 <223> Codon-Optimized HPV16 E2 fragment  
  
 <400> 76  
 cgtaggtcag ggctcacgata gcgctcttgt gcttcacgtt gtggccggtc cagtgccagg 60  
 tgctgtcac ggcggtgtac agcttgacgt gcttcttgaa gcggtaccgc 110  
  
 <210> 77  
 <211> 111  
 <212> DNA  
 <213> Artificial Sequence  
  
 <220>  
 <223> Codon-Optimized HPV16 E2 fragment  
  
 <400> 77  
 tttagatgct catgaagccg gtgctcacgg tgatgggttt ggggatcttc acctgggtca 60  
 ggaactggtc gcgctgccac tcgctgtcgt aggtcagggt cacgatagcg c 111  
  
 <210> 78  
 <211> 50  
 <212> DNA  
 <213> Artificial Sequence  
  
 <220>  
 <223> Codon-Optimized HPV16 E2 fragment  
  
 <400> 78  
 cgagctgata tcgaattcag atctgccacc atggagaccc tgtgccagcg 50  
  
 <210> 79  
 <211> 45  
 <212> DNA  
 <213> Artificial Sequence  
  
 <220>  
 <223> Codon-Optimized HPV16 E2 fragment

<400> 79  
 ggttgccagat ctagactcga gtttagatgc tcatgaagcc ggtgc 45  
  
 <210> 80  
 <211> 21  
 <212> DNA  
 <213> Artificial Sequence  
  
 <220>  
 <223> Codon-Optimized HPV16 E2 fragment  
  
 <400> 80  
 ccggctgcat caagaagcac g 21  
  
 <210> 81  
 <211> 19  
 <212> DNA  
 <213> Artificial Sequence  
  
 <220>  
 <223> Codon-Optimized HPV16 E2 fragment  
  
 <400> 81  
 ggccaaccac agcgccgcc 19  
  
 <210> 82  
 <211> 21  
 <212> DNA  
 <213> Artificial Sequence  
  
 <220>  
 <223> Codon-Optimized HPV16 E2 fragment  
  
 <400> 82  
 gccgtgcttc ttgatgcagc c 21  
  
 <210> 83  
 <211> 17  
 <212> DNA  
 <213> Artificial Sequence  
  
 <220>  
 <223> Codon-Optimized HPV16 E2 fragment  
  
 <400> 83  
 ggggtggcggc gctgtgg 17  
  
 <210> 84  
 <211> 22  
 <212> DNA  
 <213> Artificial Sequence  
  
 <220>  
 <223> Codon-Optimized HPV16 E2 fragment

<400> 84  
 cgtaggtcag ggtcacgata gc 22

<210> 85  
 <211> 109  
 <212> DNA  
 <213> Artificial Sequence

<220>  
 <223> Codon-Optimized HPV16 E7 fragment

<400> 85  
 ggccggagat ctgatatcga attcgccacc atgcacggcg acacccccac cctgcacgag 60  
 tacatgctgg acctgcagcc cgagaccacc gacctgtacg gctacggcc 109

<210> 86  
 <211> 106  
 <212> DNA  
 <213> Artificial Sequence

<220>  
 <223> Codon-Optimized HPV16 E7 fragment

<400> 86  
 gccgagcccg accgcgcccc ctacaacatc gtgaccttct gctgcaagtg cgacagcacc 60  
 ctgcgcctgt gcgtgcagag caccacgctc gacatccgca ccctgg 106

<210> 87  
 <211> 96  
 <212> DNA  
 <213> Artificial Sequence

<220>  
 <223> Codon-Optimized HPV16 E7 fragment

<400> 87  
 gggcgcggtc gggctcggcc tggccggcgg ggccgtcgat ctcgctcctct tcctcgctgc 60  
 tgtcgttcag ctggccgtag ccgtacaggt cgggtgg 96

<210> 88  
 <211> 106  
 <212> DNA  
 <213> Artificial Sequence

<220>  
 <223> Codon-Optimized HPV16 E7 fragment

<400> 88  
 ccgcggcaga tctagactcg agtttagggc ttctggctgc agattgggca cacgattccc 60  
 aggggtgccca tcagcaggtc ctccaggggt cggatgtcga cgtggg 106

<210> 89  
 <211> 25  
 <212> DNA  
 <213> Artificial Sequence

```

<220>
<223> Codon-Optimized HPV16 E7 fragment

<400> 89
ggccggagat ctgatatcga attcg                                25

<210> 90
<211> 20
<212> DNA
<213> Artificial Sequence

<220>
<223> Codon-Optimized HPV16 E7 fragment

<400> 90
ccgcggcaga tctagactcg                                20

<210> 91
<211> 105
<212> DNA
<213> Artificial Sequence

<220>
<223> Codon-Optimized HPV6a E7 fragment

<400> 91
gtcacagatc tgatatcgaa ttccaccatg cacggccgcc acgtgaccct gaaggacatc 60
gtgctggacc tgcagcctcc cgaccccgtg ggctgcaact gctac                    105

<210> 92
<211> 105
<212> DNA
<213> Artificial Sequence

<220>
<223> Codon-Optimized HPV6a E7 fragment

<400> 92
ctggaagtgc tgcttcaggg gctggctgtc ctggccgtcc acctcggtcca cctcgtcctc 60
gctgctgtcc accagctgct cgtagcagtg caggcccacg gggtc                    105

<210> 93
<211> 107
<212> DNA
<213> Artificial Sequence

<220>
<223> Codon-Optimized HPV6a E7 fragment

<400> 93
ccagcccctg aagcagcact tccagatcgt gacctgctgc tgcggctgcg acagcaacgt 60
gcgccctggtg gtgcagtgca ccgagaccga catccgcgag gtgcagc                107

<210> 94

```

<211> 102  
 <212> DNA  
 <213> Artificial Sequence

<220>  
 <223> Codon-Optimized HPV6a E7 fragment

<400> 94  
 cagtcagatc tagagatatc tttaggtctt gggagcgcag atggggcaca cgatgttcag 60  
 ggtaccacgc aggagctgct gcacctcgcg gatgtcggtc tc 102

<210> 95  
 <211> 24  
 <212> DNA  
 <213> Artificial Sequence

<220>  
 <223> PCR Primer

<400> 95  
 gtcacagatc tgatatcgaa ttcc 24

<210> 96  
 <211> 26  
 <212> DNA  
 <213> Artificial Sequence

<220>  
 <223> PCR Primer

<400> 96  
 cagtcagatc tagagatatc tttagg 26

<210> 97  
 <211> 109  
 <212> DNA  
 <213> Artificial Sequence

<220>  
 <223> Codon-Optimized HPV18 E7 fragment

<400> 97  
 gtcacagatc tgatatcgaa ttccaccatg cacggcccca aggccaccct gcaggacatc 60  
 gtgctgcacc tggagcccca gaacgagatc cccgtggacc tgctgtgcc 109

<210> 98  
 <211> 111  
 <212> DNA  
 <213> Artificial Sequence

<220>  
 <223> Codon-Optimized HPV18 E7 fragment

<400> 98  
 gggctcggcc ctgcgagcgg gcaggtgctg gtgggttcacg ccgtcgatct cgtcgttctc 60

ctcctcgctg tcgctcagct gtcctgggca cagcaggtcc acggggatct c 111

<210> 99

<211> 108

<212> DNA

<213> Artificial Sequence

<220>

<223> Codon-Optimized HPV18 E7 fragment

<400> 99

gcccgcctgc agggccgagc cccagcgcca caccatgctg tgcattgtgt gcaagtgcga 60  
ggcccgcatc gagctggttg tggagagcag cgctgacgac ctgcgcgc 108

<210> 100

<211> 109

<212> DNA

<213> Artificial Sequence

<220>

<223> Codon-Optimized HPV18 E7 fragment

<400> 100

cagtcagatc tagagatatc ttactgctg gctggcgcac caggggcaca cgaagctcag 60  
ggtgttcagg aacagctgct ggaaggcgcg caggtcgtea gcgctgctc 109

<210> 101

<211> 26

<212> DNA

<213> Artificial Sequence

<220>

<223> PCR Fragment

<400> 101

gtcacagatc tgatatcgaa ttccac 26

<210> 102

<211> 27

<212> DNA

<213> Artificial Sequence

<220>

<223> PCR Fragment

<400> 102

cagtcagatc tagagatatc ttactg 27

<210> 103

<211> 90

<212> DNA

<213> Artificial Sequence

<220>

<223> Codon-Optimized HPV6 E2 fragment

```

<400> 103
gaattcagat ctgatatcac catggaggcc atcgccaagc gcctggacgc ctgccaggag 60
cagctgctgg agctgtacga ggagaacagc                               90

<210> 104
<211> 92
<212> DNA
<213> Artificial Sequence

<220>
<223> Codon-Optimized HPV6 E2 fragment

<400> 104
ccttgtagag cagcacgctc tcgtggcgca tgcacttcca gtgcagcacg tgcttgtagc 60
ggtcggtgct gttctcctcg tacagctcca gc                               92

<210> 105
<211> 96
<212> DNA
<213> Artificial Sequence

<220>
<223> Codon-Optimized HPV6 E2 fragment

<400> 105
ccacgagagc gtgctgctgt acaaggccaa gcagatgggc ctgagccaca tcggcatgca 60
ggtggtgcct cctctgaagg tgagcgaggc caaggg                               96

<210> 106
<211> 103
<212> DNA
<213> Artificial Sequence

<220>
<223> Codon-Optimized HPV6 E2 fragment

<400> 106
gcagggtcca gggctccatg ctgtactcgg tgcgcagcag gctctcgagg tgcattctgca 60
tctcgatggc gttgtggccc ttggcctcgc tcaccttcag agg                               103

<210> 107
<211> 98
<212> DNA
<213> Artificial Sequence

<220>
<223> Codon-Optimized HPV6 E2 fragment

<400> 107
cgagtacagc atggagccct ggaccctgca ggagaccagc tacgagatgt ggcagacccc 60
tcccaagcgc tgcttcaaga agcgcggcaa gaccgtgg                               98

<210> 108
<211> 102

```

```

<212> DNA
<213> Artificial Sequence

<220>
<223> Codon-Optimized HPV6 E2 fragment

<400> 108
cgttgtcctg cacgtacacg tcggtccaca ccacgtagtc catggtgttg ttggcgcagc 60
cgtcgaactt cacctccacg gtcttgccgc gcttcttgaa gc 102

<210> 109
<211> 102
<212> DNA
<213> Artificial Sequence

<220>
<223> Codon-Optimized HPV6 E2 fragment

<400> 109
ccgacgtgta cgtgcaggac aacgacacct ggggtgaaggc gcacagcatg gtggacgcca 60
agggcatcta ctacacctgt ggccagttca agacctacta cg 102

<210> 110
<211> 92
<212> DNA
<213> Artificial Sequence

<220>
<223> Codon-Optimized HPV6 E2 fragment

<400> 110
gctgccgtag cacacctccc agtgcttggt gctgccgtac ttctcggcct ctttcacgaa 60
gttcacgtag taggtcttga actggccaca gg 92

<210> 111
<211> 94
<212> DNA
<213> Artificial Sequence

<220>
<223> Codon-Optimized HPV6 E2 fragment

<400> 111
gcactgggag gtgtgctacg gcagcaccgt gatctgcagc cccgctagcg tgagcagcac 60
caccagaggag gtgagcatcc ccgagagcac cacc 94

<210> 112
<211> 97
<212> DNA
<213> Artificial Sequence

<220>
<223> Codon-Optimized HPV6 E2 fragment

<400> 112

```

```
gcgaggaggg gtctgcacgg cgtcctcctt ggtgctgctg ctcaccaggg tgctgggtctg 60
ggcgggagtg taggtgggtgc tctcggggat gctcacc 97
```

```
<210> 113
<211> 97
<212> DNA
<213> Artificial Sequence
```

```
<220>
<223> Codon-Optimized HPV6 E2 fragment
```

```
<400> 113
ggacgccgtg cagacccctc ctcgcaagcg cgcccgcggc gtgcagcaga gccctgcaa 60
cgccctgtgc gtggcccaca tcggccccgt ggacagc 97
```

```
<210> 114
<211> 94
<212> DNA
<213> Artificial Sequence
```

```
<220>
<223> Codon-Optimized HPV6 E2 fragment
```

```
<400> 114
ggcgtgctg ttgctgttgt tgcggcgctg gtgctggctg tggttgttgg tgatcagggt 60
gtggttgccg ctgtccacgg ggccgatgtg ggcc 94
```

```
<210> 115
<211> 95
<212> DNA
<213> Artificial Sequence
```

```
<220>
<223> Codon-Optimized HPV6 E2 fragment
```

```
<400> 115
ccgcaacaac agcaacagca gcgccactcc catcgtgcag ttccagggcg agagcaactg 60
cctgaagtgc ttccgctacc gctgaacga tcgcc 95
```

```
<210> 116
<211> 96
<212> DNA
<213> Artificial Sequence
```

```
<220>
<223> Codon-Optimized HPV6 E2 fragment
```

```
<400> 116
cgtgcttgtg gggagccttg ctgctggccc agtgccagggt gctgctgatc aggtcgaaca 60
ggtggcggtg gcgatcggtc aggcggtagc ggaagc 96
```

```
<210> 117
<211> 95
<212> DNA
<213> Artificial Sequence
```

&lt;220&gt;

&lt;223&gt; Codon-Optimized HPV6 E2 fragment

&lt;400&gt; 117

gcagcaaggc tccccacaag cagccatcg tgaccgtgac ctacgacagc gaggagcagc 60  
gccagcagtt cctggacgtg gtgaagatcc ctccc 95

&lt;210&gt; 118

&lt;211&gt; 96

&lt;212&gt; DNA

&lt;213&gt; Artificial Sequence

&lt;220&gt;

&lt;223&gt; Codon-Optimized HPV6 E2 fragment

&lt;400&gt; 118

ctcgagagat ctcccgggtc tagagcttac agcaggtgca ggctcatgaa gcccagcttg 60  
tggctgatgg tgggagggat cttcaccacg tccagg 96

&lt;210&gt; 119

&lt;211&gt; 25

&lt;212&gt; DNA

&lt;213&gt; Artificial Sequence

&lt;220&gt;

&lt;223&gt; Codon-Optimized HPV6 E2 fragment

&lt;400&gt; 119

gaattcagat ctgatatcac catgg 25

&lt;210&gt; 120

&lt;211&gt; 21

&lt;212&gt; DNA

&lt;213&gt; Artificial Sequence

&lt;220&gt;

&lt;223&gt; Codon-Optimized HPV6 E2 fragment

&lt;400&gt; 120

gcagggtcca gggctccatg c 21

&lt;210&gt; 121

&lt;211&gt; 25

&lt;212&gt; DNA

&lt;213&gt; Artificial Sequence

&lt;220&gt;

&lt;223&gt; Codon-Optimized HPV6 E2 fragment

&lt;400&gt; 121

cgagtacagc atggagccct ggacc 25

&lt;210&gt; 122

&lt;211&gt; 25

```

<212> DNA
<213> Artificial Sequence

<220>
<223> Codon-Optimized HPV6 E2 fragment

<400> 122
gctgccgtag cacacctccc agtgc                25

<210> 123
<211> 21
<212> DNA
<213> Artificial Sequence

<220>
<223> Codon-Optimized HPV6 E2 fragment

<400> 123
gcactgggag gtgtgctacg g                    21

<210> 124
<211> 23
<212> DNA
<213> Artificial Sequence

<220>
<223> Codon-Optimized HPV6 E2 fragment

<400> 124
ggcgctgctg ttgctgttgt tgc                23

<210> 125
<211> 22
<212> DNA
<213> Artificial Sequence

<220>
<223> Codon-Optimized HPV6 E2 fragment

<400> 125
ccgcaacaac agcaacagca gc                22

<210> 126
<211> 26
<212> DNA
<213> Artificial Sequence

<220>
<223> Codon-Optimized HPV6 E2 fragment

<400> 126
ctcgagagat ctcccgggtc tagagc            26

<210> 127
<211> 97

```

<212> DNA

<213> Artificial Sequence

<220>

<223> Codon-Optimized HPV18 E2 fragment

<400> 127

gaattcagat ctgatatcac catgcagact cccaaggaga ccctgagcga gcgcctgagc 60  
gccctgcagg acaagatcat cgaccactac gagaacg 97

<210> 128

<211> 98

<212> DNA

<213> Artificial Sequence

<220>

<223> Codon-Optimized HPV18 E2 fragment

<400> 128

cgaagaagat ggcgttctcc cagcggatca gctgccagta ctggatctgg ctgtcgaatgt 60  
ccttgctgtc gttctcgtag tggtcgatga tcttgctc 98

<210> 129

<211> 94

<212> DNA

<213> Artificial Sequence

<220>

<223> Codon-Optimized HPV18 E2 fragment

<400> 129

ccgctgggag aacgccatct tcttcgccgc tcgcgagcac gggatccaga ccctgaacca 60  
ccaggtggtg cccgcctaca acatcagcaa gagc 94

<210> 130

<211> 94

<212> DNA

<213> Artificial Sequence

<220>

<223> Codon-Optimized HPV18 E2 fragment

<400> 130

cctcgggtctt gtaggcgctc tgggccaggc cctgcagggc catctgcagc tcgatggcct 60  
tgtgggcctt gctcttgctg atgtttagg cggg 94

<210> 131

<211> 91

<212> DNA

<213> Artificial Sequence

<220>

<223> Codon-Optimized HPV18 E2 fragment

<400> 131

cccagagcgc ctacaagacc gaggactgga ccctgcagga cacctgcgag gagctgtgga 60  
acaccgagcc caccactgc ttcaagaagg g 91

<210> 132

<211> 94

<212> DNA

<213> Artificial Sequence

<220>

<223> Codon-Optimized HPV18 E2 fragment

<400> 132

gctgtcccag gccacgtagt tcatgcagtt gtccttggtg ccgtcgaagt acacctgcac 60  
ggtctggcct cccttcttga agcagtgggt gggc 94

<210> 133

<211> 90

<212> DNA

<213> Artificial Sequence

<220>

<223> Codon-Optimized HPV18 E2 fragment

<400> 133

gcatgaacta cgtggcctgg gacagcgtgt actacatgac cgacgccggc acctgggaca 60  
agaccgccac ctgcgtgagc caccgcggcc 90

<210> 134

<211> 92

<212> DNA

<213> Artificial Sequence

<220>

<223> Codon-Optimized HPV18 E2 fragment

<400> 134

ccgtacttct cgcactcgct cttgaactcg atgtagaagg tggtgtagcc ctccttcacg 60  
tagtacaggc cgcggtggct cagcaggtg gc 92

<210> 135

<211> 94

<212> DNA

<213> Artificial Sequence

<220>

<223> Codon-Optimized HPV18 E2 fragment

<400> 135

cgagttcaag agcgagtgcg agaagtacgg caacaccggc acctgggagg tgcacttcgg 60  
caacaacgtg atcgactgca acgacagcat gtgc 94

<210> 136

<211> 100

<212> DNA

<213> Artificial Sequence

&lt;220&gt;

&lt;223&gt; Codon-Optimized HPV18 E2 fragment

&lt;400&gt; 136

gctgtagggg ctgggagtgt gctgcagctg cttcaccagc tgggtggcgc tcacggtgtc 60  
 gtcgctgggtg ctgcacatgc tgcgttgca gtcgatcacg 100

&lt;210&gt; 137

&lt;211&gt; 93

&lt;212&gt; DNA

&lt;213&gt; Artificial Sequence

&lt;220&gt;

&lt;223&gt; Codon-Optimized HPV18 E2 fragment

&lt;400&gt; 137

gcacactccc agcccctaca gcagcacctg gagcgtgggc accgccaaga cctacggcca 60  
 gaccagcgcc gccactcgcc ctggccactg cgg 93

&lt;210&gt; 138

&lt;211&gt; 96

&lt;212&gt; DNA

&lt;213&gt; Artificial Sequence

&lt;220&gt;

&lt;223&gt; Codon-Optimized HPV18 E2 fragment

&lt;400&gt; 138

gcttggtggt gccggtggcg gtggcggcgc ccagcagagg gttcacgggc ccgcagtgct 60  
 gcttctcggc caggccgcag tggccagggc gagtgg 96

&lt;210&gt; 139

&lt;211&gt; 97

&lt;212&gt; DNA

&lt;213&gt; Artificial Sequence

&lt;220&gt;

&lt;223&gt; Codon-Optimized HPV18 E2 fragment

&lt;400&gt; 139

gccaccgcca ccggcaacaa caagcgccgc aagctgtgca gcggcaacac cactcccatc 60  
 atccacctga agggcgaccg caacagcctg aagtgcc 97

&lt;210&gt; 140

&lt;211&gt; 97

&lt;212&gt; DNA

&lt;213&gt; Artificial Sequence

&lt;220&gt;

&lt;223&gt; Codon-Optimized HPV18 E2 fragment

&lt;400&gt; 140

ggcgccgggtc cagtgccagg tgctgctgat gtcgcggtag tggtcgctgt gcttgccgag 60  
 gcggtaccgc aggcacttca ggctgttgcg gtcgccc 97

<210> 141  
 <211> 99  
 <212> DNA  
 <213> Artificial Sequence  
  
 <220>  
 <223> Codon-Optimized HPV18 E2 fragment  
  
 <400> 141  
 gcacctggca ctggaccggc gccgggaacg agaagaccgg catcctgacc gtgacctacc 60  
 acagcgagac ccagcgcacc aagttcctga acaccgtgg 99  
  
 <210> 142  
 <211> 98  
 <212> DNA  
 <213> Artificial Sequence  
  
 <220>  
 <223> Codon-Optimized HPV18 E2 fragment  
  
 <400> 142  
 ctcgagagat ctcccgggtc tagagcttac atgggtcatgt agcccaccag gatctgcacg 60  
 ctgtcgggga tggccacggt gttcaggaac ttggtgcg 98  
  
 <210> 143  
 <211> 25  
 <212> DNA  
 <213> Artificial Sequence  
  
 <220>  
 <223> Codon-Optimized HPV18 E2 fragment  
  
 <400> 143  
 gaattcagat ctgatatcac catgc 25  
  
 <210> 144  
 <211> 23  
 <212> DNA  
 <213> Artificial Sequence  
  
 <220>  
 <223> Codon-Optimized HPV18 E2 fragment  
  
 <400> 144  
 cctcggctctt gtaggcgctc tgg 23  
  
 <210> 145  
 <211> 21  
 <212> DNA  
 <213> Artificial Sequence  
  
 <220>  
 <223> Codon-Optimized HPV18 E2 fragment

<400> 145  
 cccagagcgc ctacaagacc g 21  
  
 <210> 146  
 <211> 21  
 <212> DNA  
 <213> Artificial Sequence  
  
 <220>  
 <223> Codon-Optimized HPV18 E2 fragment  
  
 <400> 146  
 ccgtacttct cgcactcgct c 21  
  
 <210> 147  
 <211> 20  
 <212> DNA  
 <213> Artificial Sequence  
  
 <220>  
 <223> Codon-Optimized HPV18 E2 fragment  
  
 <400> 147  
 cgagttcaag agcgagtgcg 20  
  
 <210> 148  
 <211> 21  
 <212> DNA  
 <213> Artificial Sequence  
  
 <220>  
 <223> Codon-Optimized HPV18 E2 fragment  
  
 <400> 148  
 gcttggtggt gccggtggcg g 21  
  
 <210> 149  
 <211> 25  
 <212> DNA  
 <213> Artificial Sequence  
  
 <220>  
 <223> Codon-Optimized HPV18 E2 fragment  
  
 <400> 149  
 gccaccgcca ccggcaacaa caagc 25  
  
 <210> 150  
 <211> 26  
 <212> DNA  
 <213> Artificial Sequence  
  
 <220>  
 <223> Codon-Optimized HPV18 E2 fragment

<400> 150  
ctcgagagat ctcccgggtc tagagc

26